REMARKS

This paper is filed in response to the Final Office action mailed on October 9, 2007. Original claims 1-45 and 51-76 have been canceled, and new claims 77-96 are presented herewith. In view of the foregoing amendments and following comments, Applicants respectfully request reconsideration and allowance of all pending claims.

Turning to the Office action, all of the previously pending claims were rejected as obvious over a combination of at least U.S. Patent No. 6,354,097 ("Schuster") in view of U.S. Patent No. 5,946,928 ("Wiggs"). U.S. Patent Application Publication No. 2002/0194862 ("Komatsubara") and U.S. Patent No. 6,227,003 ("Smolinsky") were also cited against some of the dependent claims. Of the rejected claims, only claims 46-50 remain pending in the application. The following remarks identify the distinguishing characteristics of claims 46-50, as well as the claims added herein, with respect to the cited prior art. Accordingly, reconsideration and allowance of the claims are respectfully requested.

More specifically, independent claim 46, as well as claims 47-50 depending directly or indirectly thereon, specifies a heat exchange system including a direct expansion geothermal heat exchange system having a system operational pressure and a system refrigerant fluidly positioned in the direct expansion geothermal heat exchange system, wherein the system operational pressure is consistently maintained at least 33% greater than a working pressure of R-22 refrigerant.

Independent claim 77, as well as claims 78-80 depending directly or indirectly thereon, specifies a method of designing a direct expansion geothermal heat exchange system comprising. The method includes connecting an interior heat exchanger and an exterior, sub-surface, heat exchanger with a compressor using refrigerant grade tubing, charging the system with a system refrigerant that has a working pressure at least 33% greater than a working pressure of R-22 refrigerant, and operating the system with a continuous operational pressure at least 33% greater than the working pressure of R-22 refrigerant.

Independent claim 81, as well as claims 82-84 depending directly or indirectly thereon, specifies a direct expansion geothermal heat exchange system having an operational working pressure. The heat exchange system includes a compressor, an interior heat exchanger, an

exterior, sub-surface, heat exchanger, and refrigerant grade tubing connecting the interior heat exchanger and the exterior, sub-surface, heat exchanger with the compressor. A system refrigerant charges the system, wherein the system refrigerant has a working pressure at least 33% greater than a working pressure of R-22 refrigerant. The system operates with a continuous operational pressure at least 33% greater than the working pressure of R-22 refrigerant.

Independent claim 85, as well as claims 86-88 depending directly or indirectly thereon, specifies a method of exchanging heat in a direct expansion geothermal heat exchange system. The method includes providing an above-ground, interior heat exchanger and a sub-surface exterior heat exchanger. The interior and exterior heat exchangers are operably connected to a compressor using refrigerant-grade tubing. The geothermal heat exchange system is charged with a refrigerant having a working pressure at least 33% greater than a working pressure of R-22, and the compressor is operated to continuously maintain the geothermal heat exchange system at the working pressure of the refrigerant.

Independent claim 89, as well as claims 90-92 depending directly or indirectly thereon, specifies a heat exchange system comprising a direct expansion geothermal heat exchange system having an operational pressure and including, a compressor, an interior heat exchanger, an exterior, sub-surface, heat exchanger, and refrigerant-grade tubing connecting the interior and exterior heat exchangers with the compressor. The system is charged with a refrigerant having a working pressure at least 33% greater than a working pressure of R-22. The compressor is sized and operated to continuously maintain the operational pressure of the geothermal heat exchange system at the working pressure of the refrigerant.

Independent claim 93, as well as claim 94 depending directly thereon, specifies a direct expansion geothermal heat exchange system having an operational pressure and a heat exchange capacity. The geothermal heat exchange system includes a compressor, a polyol ester lubricating oil positioned to lubricate the compressor, an interior heat exchanger, a filter dryer in fluid communication with the interior heat exchanger, the filter dryer being oversized by a factor of at least 10% in comparison to a size of a filter dryer used in an R-22 based system having a similar heat exchange capacity, an exterior, sub-surface, heat exchanger, refrigerant grade tubing connecting the interior heat exchanger and the exterior, sub-surface, heat exchanger with the compressor, and a system refrigerant charging the system, wherein the system refrigerant has a

working pressure at least 33% greater than a working pressure of R-22. The compressor is sized to continuously maintain the operational pressure of the geothermal heat exchange system at the working pressure of the refrigerant.

Independent claim 95, as well as claim 96 dependent directly thereon, specifies a direct expansion geothermal heat exchange system having an operational pressure and a heat exchange capacity. The geothermal heat exchange system includes a compressor, an interior heat exchanger, and an exterior, subsurface heat exchanger. Refrigerant grade tubing connects the interior heat exchanger and the exterior heat exchanger with the compressor, and a system refrigerant charges the system, wherein the system refrigerant is an R-410A refrigerant. A polyol ester lubricating oil is positioned to lubricate the compressor. The compressor, interior and exterior heat exchangers, and refrigerant grade tubing are configured to withstand a system operational pressure at least 33% greater than a working pressure of R-22 refrigerant

New claims 77-96 submitted herewith are fully supported by the original specification and drawings. Specifically, interior and exterior heat exchangers, as well as refrigerant-grade tubing connecting the heat exchangers to a compressor, are illustrated in Fig. 1 and accompanying written description at paragraphs [99] and [101]. A refrigerant working pressure at least 33% greater than R-22 was disclosed and claimed in original claim 13. Geothermal heat exchanger components, which include a compressor, capable of operating at a working pressure at least 33% greater than that for R-22 are disclosed and claimed in original claim 47. Accordingly, no new matter is presented in the new claims.

Turning to the prior art, claims 46-50 and 77-96 are patentable over the proposed combination of Schuster and Wiggs. Specifically, the cited prior art fails to disclose or suggest a geothermal heat exchange system or method that continuously maintains a refrigerant at a working pressure at least 33% greater than that for R-22 (claims 46-50 and 77-94), or that includes components configured to withstand a system operational pressure at least 33% greater than a working pressure of R-22 refrigerant (claims 95-96). The Examiner relies on Schuster for disclosing R-410A and noting that it has operating pressures up to 70% higher than R-22. Schuster does not, however disclose or suggest operating a heat exchange system at such an elevated pressure. To the contrary, Schuster teaches away from such a system by disclosing apparatus that allows R-410A to be used at a lower operational pressure more similar to that of

R-22. Specifically, Schuster teaches that the system operational pressures can be lowered to within the safe working load/burst strength range of an R-22 system by lowering or eliminating the power to an outdoor fan on an exterior fan coil. It does not disclose or suggest running a heat exchange system at a working pressure elevated above that of R-22 on a continuous basis. Consequently, Schuster does not disclose or suggest a geothermal heat exchange system that is charged with a refrigerant having a working pressure at least 33% greater than a working pressure of R-22, and a compressor operated to continuously maintain the geothermal heat exchange system at the elevated working pressure of the refrigerant, as specified in each pending claim.

Furthermore, the differences in the types of heat exchange systems used in Schuster and specified in the claims would render irrelevant any suggestion by Schuster of a particular refrigerant. Schuster is a conventional air-source system that uses exterior convective heat transfer, while the direct exchange system specified in the claims uses exterior conductive heat transfer. One of ordinary skill in the art would appreciate the differences in heat transfer methods between the two systems, and would understand that the use of refrigerant in one system does not necessarily translate to the other. Accordingly, to the extent that Schuster discloses the use of R-410, that teaching is limited to air-source systems using exterior convective heat transfer, and is not applicable to the claimed direct exchange system which uses exterior conductive heat transfer.

Contrary to the Examiner's assertion otherwise, Schuster does not disclose, explicitly or implicitly, that refrigerants having higher operational pressures are desirable in all applications. On page 7 of the Office action, the Examiner states, "Schuster implicitly contends that R-410A is the refrigerant to be used in all systems over R-22 because it has higher operational pressures ..." The Examiner's allegation is factually untrue and technically incorrect. One of ordinary skill in the art would consider several factors in addition to operational pressure when selecting a refrigerant for a particular heat exchange system. There is no general consensus in the art that a higher operational pressure is somehow "better" for all heat exchange applications. Furthermore, Schuster itself refutes such an implication, because it teaches how to maintain the operational pressures of an air-source system using a higher pressure R-410A refrigerant within the lower

pressure range of an R-22 based system. Accordingly, Schuster would remove any alleged benefits of a higher pressure refrigerant by operating it at a lower pressure.

While Schuster acknowledges that R-410A is capable of higher operating pressures, it fails to disclose or suggest that an R-410A refrigerant improves heat transfer in the Schuster system The Examiner improperly argues on Page 6 that R-410A has "higher operating pressures over R-22 which allows for a greater amount of heat transfer to occur in the system " Simply increasing operational pressure does not necessarily increase heat transfer.

Instead, Applicant was the first to discover the unexpected and advantageous effects of using a higher working pressure refrigerant, such as R-410A, in an exterior conductive heat exchanger, such as the direct exchange system disclosed in the present application. Higher working pressure refrigerant, and R-410A in particular, overcomes the adverse effects of gravity when a direct exchange system operates in the cooling mode The effects of gravity are significant in a geothermal heat exchange system due to the elevations traversed by the underground exterior heat exchanger. Additionally, Applicant has found that higher pressure refrigerants such as R-410A improve operational efficiencies and heat transfer when used in relatively constant temperatures and conditions, such as those found below ground. Such conditions are prevalent at the underground, exterior heat exchanger specified in the claims. These considerations are inapplicable and/or irrelevant to the air source system of Schuster

The secondary reference to Wiggs discloses a direct expansion system, but does not teach or suggest the use of a refrigerant having a working pressure at least 33% greater than a working pressure of R-22, and therefore similarly fails to disclose or suggest each element of the pending claims.

The proposed combination of cited prior art also fails to disclose or suggest the additional elements recited in independent claims 93 and 95. As noted above, independent claims 93 and 95 also recite a polyol ester lubricating oil positioned to lubricate the compressor. Independent claim 93 further recites a filter dryer in fluid communication with the interior heat exchanger, the filter dryer being oversized by a factor of at least 10% in comparison to a size of a filter dryer used in an R-22 based system having a similar heat exchange capacity. The Examiner cites Komatsubara as responsive to the polyol ester lubricating oil and Smolinsky as responsive to the

filter dryer element Applicants traverse this ground of rejection to the extent it is applicable to new claims 93-96

More specifically, Komatsubara fails to disclose or suggest the combination of polyol ester lubricating oil in combination with a direct expansion geothermal heat exchange system. The Office Action alleges that paragraph [0037] of Komatsubara teaches providing polyol ester lubricating oil for a system's compressor That paragraph, however, references multiple oils "that can be used as the refrigerating device oil at the refrigerating device of the present invention." Furthermore, the refrigerant used in Komatsubara is not one having an elevated working pressure such as R-410A refrigerant, but instead Komatsubara teaches a refrigerant that has a special odorant making it easy to detect leakage, and one that will not adversely react with multiple potential oil types (See Komatsubara at paragraphs [0069] and[0070], and claim 1 on page 5) Consequently, Komatsubara does not teach, and provides no information so that one skilled in the art could conceivably know, which oil type one should preferably utilize with a refrigerant having an elevated working pressure such as R-410A refrigerant. In fact, if the various other oils mentioned in Komatsubara's paragraph [0037] (all of which are fine for Komatsubara's special refrigerant which is not an R-410A refrigerant) were used in Applicant's system as specified in the claims, the compressor would eventually fail

Furthermore, Komatsubara employs a fundamentally different heat exchange system than the present invention, and therefore its disclosure of oils for that system would not fairly teach or suggest the use of the same oils in the presently claimed system Komatsubara identifies polyol ester as one of multiple oils that may be used in conjunction with flammable refrigerants in its air-source heat pump FIG. 1 of Komatsubara clearly shows an air-source system having a flow of refrigerant during a defrost cycle (see pages 2 and 3, paragraph [0031]). In the current claims, the system is a direct expansion and/or geothermal heat exchange system that uses a refrigerant having an elevated working pressure, such as R-410A. These systems do not have such a defrost cycle. One of ordinary skill in the art would understand that the different heat exchange systems and refrigerants would necessitate different characteristics in lubricating oil, and therefore the disclosure of a particular oil for one system would not necessarily indicate that it is desirable for use in the other system.

Turning to Smolinsky, that reference fails to disclose or suggest the filter dryer element as recited in claim 93. Smolinsky generally discloses a filter dryer at col. 5, lines 43-46, which states, "The conduit assembly (50) may also include a dual direction filter dryer (60) to remove moisture and contaminants from the system; however, the filter dryer (600 may be disposed elsewhere in the system." Smolinsky fails, however, to teach or suggest that the filter dryer is oversized by at least 10% with respect to that used in an R-22 system having a similar heat exchange capacity.

Furthermore, one of ordinary skill in the art, upon reading Smolinsky, would not find it obvious to provide an oversized filter dryer as specified in the claims. The Examiner incorrectly assumes as much in stating that "it would have been obvious to provide a larger filter dryer since the system is operating under increased working pressures and system components must be adopted to accommodate this." Applicant has found that the higher operating pressures of the presently claimed system do not require a larger filter dryer, and therefore the Examiner's basis for the alleged teaching in Smolinsky is incorrect

Instead, Applicant has found that a larger filter dryer is advantageous in the presently claimed system because of the particular type of lubricating oil used and the operating conditions associated with direct expansion geothermal heat exchange systems. More specifically, polyol ester has been found to more readily absorb water vapor/moisture than conventional oils (such as Suniso 3GS commonly used with R-22 refrigerant based systems). To avoid corrosion of system components and other deleterious effects associated with water vapor/moisture, Applicant has found that a larger (by at least a factor of 10%) filter dryer is needed than what normally would be required in an R-22 based system. Additionally, field testing by Applicant has demonstrated the larger filter/dryer helps reduce psi pressure drop as R-410A refrigerant travels through the filter/dryer, which is materially advantageous to a DX system's operational efficiencies. Further, field testing by Applicant has evidenced that DX systems are prone to encountering more debris than conventional air-source system designs, due to significant sub-surface work. Thus, the use of at least a 10% larger filter dryer has proven to provide the ability to retain excessive debris, while not impairing design refrigerant flow rates. For these reasons, and not the higher working pressure of the refrigerant as suggested by the Examiner, Applicant has found that a larger filter dryer is desirable in the presently claimed system.

In view of the foregoing, the proposed combinations of prior art fail to disclose each element of claims 46-50 and 77-96, and therefore the obviousness rejections asserted in the Office action must be withdrawn.

CONCLUSION

It is submitted that the present application is in good and proper form for allowance. A favorable action on the part of the Examiner is respectfully solicited.

If, in the opinion of the Examiner, a telephone conference would expedite prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

The Patent Office is hereby authorized to credit any overpayment or charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith to our Deposit Account No. 50-3629.

Respectfully submitted,
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